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EXAMINER

DIAZ, JOSE R

ART UNIT PAPER NUMBER

2815

DATE MAILED: 06/03/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/497,320

Applicant(s)

GHAEMMAGHAMI ET AL. 

Examiner

José R Díaz

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 09 February 2004.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1,4-8,11,12 and 14-20 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☒ Claim(s) 15-17 is/are allowed.
- 6) ☒ Claim(s) 1,4,5,7,8,11,12,14 and 18-20 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
 - ☐ Certified copies of the priority documents have been received in Application No. _____.
 - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____
- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date _____
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____

DETAILED ACTION

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

Claims 1, 4-5, 8, and 11-12 are still rejected under 35 U.S.C. 103(a) as being unpatentable over Hori et al. (US Pat. No. 5,320,974) in view of Wolf et al. ("Silicon Processing for the VLSI Era, Volume 1-Process Technology", Lattice Press, 1986, pp. 321-324), previously cited in the Office action mailed on May 6, 2003.

Regarding claims 1 and 8, Hori et al. teach a method for providing a halo implant in a semiconductor device comprising the steps of: providing a thin mask layer (MASK) to the semiconductor device (N + POLY-Si GATE) (see figs. 3-4) that covers a substantial amount of an active area (DRAIN REGION) (see figs. 3-4. Also, please note

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that figs. 3-4 show only a portion of the device of the example disclosed in figs. 1C and 2A-2C, in which the mask (8a) is also provided over the source region (7a)) comprising a source region (7a) (figs. 1C and 2A-2C) and a drain (DRAIN REGION) region of the semiconductor device (N + POLY-Si GATE) (see figs. 3-4); and providing the halo implant (B+) (see figs. 1C, 2A-2C, and 3).

However, Hori et al. fails to teach thin mask comprising photoresist. Wolf et al. teaches that photoresist is a conventional alternative implantation mask material used in the art (see last paragraph of page 321 of Wolf et al.).

Hori et al. and Wolf et al. are analogous art because they are from the same field of endeavor as applicant's invention. At the time of the invention it would have been obvious to a person of ordinary skill in the art to use photoresist instead of a metal or an oxide film as the ion implantation mask material. The motivation for doing so, as is taught by Wolf et al., is that photoresist have good ion stopping power in the smallest thickness (see last paragraph of page 321 of Wolf et al.). Therefore, it would have been obvious to combine Wolf et al. with Hori et al. to obtain the invention of claims 1, 4, 5, 8, 11 and 12.

Regarding claims 4 and 11, Hori et al. teach that a halo implant angle of about 45° (see col. 6, lines 60-63).

Regarding claims 5 and 12, Hori et al. teach providing LDD regions (6a and 6b) (see Figs. 1A and 2C) before the halo implant (B+) (see figs. 1C).

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Claims 7 and 14 are still rejected under 35 U.S.C. 103(a) as being unpatentable over Hori et al. (US Pat. No. 5,320,974) in view of Wolf et al. ("Silicon Processing for the VLSI Era, Volume 1-Process Technology", Lattice Press, 1986, pp. 321-324), and further in view of Thackeray et al. (US Pat. No. 6,037,107).

Regarding claims 7 and 14, a further difference between the prior art and the claimed invention is the use of DUV. Thackeray et al. teaches that it is well known in the art to expose the photoresist mask to deep ultraviolet (DUV) radiation (see col. 1, lines 35-38).

Hori et al., Wolf et al. and Thackeray et al. are analogous art because they are from the same field of endeavor as applicant's invention. At the time of the invention it would have been obvious to a person of ordinary skill in the art to expose the photoresist mask to deep ultraviolet (DUV) radiation. The motivation for further doing so, as is taught by Thackeray et al., is that DUV exposure provides patterns of reduced feature size (see col. 1, lines 35-38). Therefore, it would have been obvious to further combine Thackeray et al. with Hori et al. and Wolf et al. to obtain the invention of claims 7 and 14.

Claims 18-19 are rejected under 35 U.S.C. 103(a) as being unpatentable over Rodder (EP 0 899 793 A2).

Regarding claim 18, Rodder teaches a gate (22) (see fig. 1A), an oxide trench (16, 18) (see fig. 1A), a drain region (consider portion 96 of the active region 20) adjacent to said oxide trench (18) (see fig. 1E), a source region (consider portion 92 of

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the active region 20) adjacent to said oxide trench (16) (see fig. 1E), and a thin photoresist layer (30) (see fig. 1B and col. 4, lines 53-54) of, for example, 0.3 μm thick (col. 6, lines 7-8) over said oxide trench (16, 18) and a substantial portion of said source (92) and drain region (96) (see fig. 1B), wherein a halo implant (70, 72) is implanted using said photoresist layer and said gate as a mask (see fig. 1C). With regards to the claimed thickness of 0.1-0.2 μm , Rodder further teaches that the masking layer (30) may comprise other thickness (see col. 6, lines 8-9). It would have been obvious to one of ordinary skill in the art to include a photoresist of a thickness between 0.1-0.2 μm , since it has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or working ranges involves only routine skill in the art. *In re Huang*, 40 USPQ2d 1685,1688(Fed. Cir. 1996) citing *In re Aller*, 105 USPQ 233, 235 (CCPA 1955). The motivation for controlling the thickness of the photoresist in the manner described above is reducing the shadowing effect during the implantation process.

Regarding claim 19, Rodder teaches that an implant angle of, for example, 7-30 degrees (col. 12, lines 38-39). It would have been obvious to one of ordinary skill in the art to include an implant angle of 45 degrees, since it has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or working ranges involves only routine skill in the art. *In re Huang*, 40 USPQ2d 1685,1688(Fed. Cir. 1996) citing *In re Aller*, 105 USPQ 233, 235 (CCPA 1955). The motivation for adjusting the implant angle in the manner described above is forming halo

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region of a desired size and depth that greatly reduce capacitance of the transistor (col. 12, lines 41-44 of Rodder). it would have been obvious to one of ordinary skill in the art,

Claim 20 is rejected under 35 U.S.C. 103(a) as being unpatentable over Rodder (EP 0 899 793 A2) in view of Thackeray et al. (US Pat. No. 6,037,107)

Regarding claim 20, Rodder fails to teach the use of DUV. Thackeray et al. teaches that it is well known in the art to expose the photoresist mask to deep ultraviolet (DUV) radiation (see col. 1, lines 35-38).

Rodder and Thackeray et al. are analogous art because they are from the same field of endeavor as applicant's invention. At the time of the invention it would have been obvious to a person of ordinary skill in the art to expose the photoresist mask to deep ultraviolet (DUV) radiation. The motivation for further doing so, as is taught by Thackeray et al., is to effectively activate the photoactive component of the photoresist system (see col. 12, lines 60-62 and col. 13, lines 1-6). Therefore, it would have been obvious to further combine Thackeray et al. with Rodder to obtain the invention of claim 20.

Allowable Subject Matter

Claims 15-17 are allowed.

The following is a statement of reasons for the indication of allowable subject matter: the prior art fails to teach, disclose, or suggest, either alone or in combination, a method comprising the steps of providing a first photoresist of a thickness 0.55 μm or

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greater over an oxide of a semiconductor device; providing a lightly doped drain implant; removing the first photoresist; providing a second photoresist layer of a thickness between 0.1-0.2 μm over the oxide trench and a substantial portion of a source and drain region; and implanting a halo implant using the second photoresist layer as a mask.

Response to Arguments

Applicant's arguments with respect to claims 18-20 have been considered but are moot in view of the new grounds of rejection.

With respect to claims 1, 4-5, 7-8, 11-12 and 14, Applicant argues that if Wolf and Hori were combined, the device of Hori could no longer function. However, this misunderstands the rejection. As applicant points out, Hori does disclose a device using TiSi_2 as a mask. However, Hori also teaches an embodiment using a SiO_2 mask, which is the embodiment used in the rejection as repeated above. Hori does not expressly teach the use of photoresist as such a mask, but Wolf makes obvious the use of photoresist in place of SiO_2 as a mask. As such, the claims are considered obvious in light of Hori in view of Wolf.

In further arguments, applicant also states that evidence must be supplied to show the ion stopping power of photoresist as compared to TiSi_2 . Again, as pointed out above, this argument misunderstands the rejection. Hori teaches the use of SiO_2 as an ion implant mask and shows distinctly in figure 3 the resultant ion implant profile when using SiO_2 as a mask. Wolf teaches that photoresist is a known material substitute for

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SiO₂ and also provides two graphs, e.g. figures 36(a) and 36(b), teaching ion implantation energy versus thickness for photoresist and SiO₂, respectively. As taught by Wolf, both SiO₂ and photoresist have the ability to stop 99.99% of ionic species for a given thickness (which thickness are within the range as claimed later by applicant). In all, a comparison of TiSi₂ and photoresist is not necessary.

Regarding the use of Thackeray, applicant argues that the rejection must fail because objective evidence has not been supplied to support the rejection and instead the examiner has merely supplied a subjective opinion. Specifically, applicant argues that it is merely the examiner's subjective opinion that one of skill in the art would be motivated to use Thackeray's teaching for providing DUV photoresist to achieve patterns of reduced feature size. However, applicant's argument must fail because the motivation is expressly provided by Thackeray in light of Hori, not the examiner. It is expressly stated by Thackeray that use of the DUV photoresist would allow reduced feature size. This is not the examiner's subjective opinion, but an objective teaching of Thackeray (col. 1 lines 35-38). Furthermore, Hori teaches in column 1, lines 10-14, the concern of increasing device density. It is known in the art that device density is increased by reducing device feature size. As such, motivation exists, in objective form, to combine Hori and Thackeray as was made clear in the above rejection. The arguments are not convincing.

Finally, applicant attacks the combination of Thackeray Hori and Wolf, stating that the combination will destroy the function of Hori. However, as pointed out above

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this argument is not convincing, as the function of Hori will not change as a result of the combination.

Conclusion

The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. IBM Technical Disclosure Bulleting (NN 9305233) discloses a halo implantation process using a thin mask (see fig. 3).

THIS ACTION IS MADE FINAL. Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than **SIX MONTHS** from the mailing date of this final action.

Correspondence


Any inquiry concerning this communication or earlier communications from the examiner should be directed to José R. Díaz whose telephone number is (571) 272-1727. The examiner can normally be reached on 9:00-5:00 Monday through Friday.

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If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Tom Thomas can be reached on (571) 272-1664. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

JRD
5/15/04


GEORGE ECKERT
PRIMARY EXAMINER